Updated Status of Federally Listed ESUs of West Coast Salmon and Steelhead

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B.2.10 CALIFORNIA CENTRAL VALLEY STEELHEAD

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B.2.10.1 Summary of Previous BRT Conclusions

Summary of major risk factors and status indicators

Steelhead were once widespread throughout the Central Valley (CACSS, 1998; Reynolds et al. 1993). Steelhead require cool water in which to oversummer, and much of this habitat is now above impassable dams. Where steelhead are still extant, natural populations subject to habitat degradation, including various effects of water development and land use practices. Concerns of the BRT included extirpation from most of historical range, a monotonic decline in the single available time series of abundance (Table B.2.10.1; Figure B.2.10.1), declining proportion of wild fish in spawning runs, substantial opportunity for deleterious interactions with hatchery fish (including out-of-basin origin stocks), various habitat problems, and no ongoing population assessments. Compared to most chinook salmon populations in the Central Valley, steelhead spawning above Red Bluff Diversion Dam (RBDD) had a fairly strong negative population growth rate and small population size at the time of last census (1993) (Figure B.2.10.2).

Table B.2.10.1. Summary statistics for Central Valley steelhead trend analyses. Numbers in parentheses are 0.90 confidence intervals. Threatened and endangered chinook salmon populations are shown for comparison. Note that for steelhead, the 5-yr geometric mean refers to the period ending in 1993. There is insufficient recent data to calculate a short-term trend in abundance.

Population	5-yr mean	5-yr min	5-yr max	λ	μ	LT trend	ST trend
Sacramento River steelhead	1,952	1,425	12,320	0.95 (0.90, 1.02)	-0.07 (-0.13, 0.00)	-0.09 (-0.13, -0.06)	NA
Sacramento River winter chinook	2,191	364	65,683	0.97 (0.87, 1.09)	-0.10 (-0.21, 0.01)	-0.14 (-0.19, -0.09)	0.26 (0.04, 0.48)
Butte Creek spring chinook	4,513	67	4,513	1.30 (1.09, 1.60)	0.11 (-0.05, 0.28)	0.11 (0.03, 0.19)	0.36 (0.03, 0.70)
Deer Creek spring chinook	1,076	243	1,076	1.17 (1.04, 1.35)	0.12 (-0.02, 0.25)	0.11 (0.02, 0.21)	0.16 (-0.01, 0.33)
Mill Creek spring chinook	491	203	491	1.19 (1.00, 1.47)	0.09 (-0.07, 0.26)	0.06 (-0.04, 0.16)	0.13 (-0.07, 0.34)

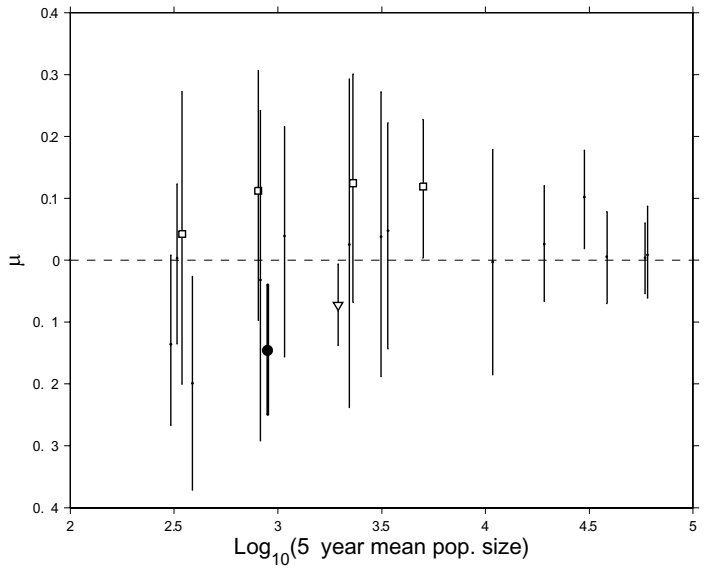

Figure B.2.10.1. Abundance and growth rate of Central Valley salmonid populations. Large filled circle- steelhead above RBDD; open squares- spring chinook; open triangle- winter chinook; small black dots- other chinook stocks (mostly fall runs). Error bars represent central 0.90 probability intervals for μ estimates. (Note: as defined in other sections of the status reviews, $\mu \approx \log[\lambda]$.)

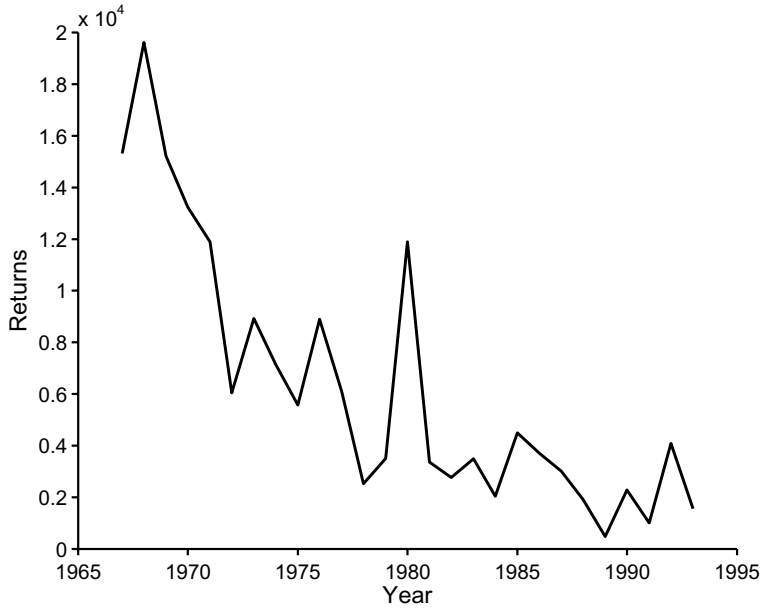

Figure B.2.10.2. Counts of steelhead passing the Red Bluff Diversion Dam fish ladders. These fish include hatchery fish from Coleman NFH.

Previous BRT Conclusions

The BRT previously concluded that the Central Valley ESU was in danger of extinction (Busby et al. 1996), and this opinion did not change in two status review updates (NMFS 1997; NMFS 1998a). The Nimbus Hatchery and Mokelumne River Hatchery steelhead stocks were excluded from the Central Valley ESU (NMFS 1998b).

Listing status

The Central Valley steelhead ESU was listed as Threatened on March 19, 1998.

B.2.10.2 New Data and Updated Analyses

Historic distribution and abundance

McEwan (2001) reviewed the status of Central Valley steelhead. Steelhead probably occurred from the McCloud River and other northern tributaries to Tulare Lake and the Kings River in the southern San Joaquin Valley. McEwan also guessed that more than 95% of historical spawning habitat is now inaccessible. He did not hazard a guess about current abundance. He guessed, on the basis of the fairly uncertain historical abundance estimates of Central Valley chinook reported by Yoshiyama et al. (1998), that between 1 million and 2 million steelhead may have once spawned in the Central Valley. McEwan's estimate is based on the observation that presently, steelhead are found in almost all systems where spring-run chinook salmon occur and can utilize elevations and gradients even more extreme than those used by spring chinook, as well as mid-elevation areas not used by spring chinook. Steelhead should therefore have had more freshwater habitat than spring chinook, and the sizes of steelhead populations should therefore have been roughly comparable those of spring chinook.

Current Abundance

One source of new abundance information since the last status review comes from midwater trawling below the confluence of the Sacramento and San Joaquin Rivers at Chipps Island. This trawling targets juvenile chinook; catches of steelhead are incidental. In a trawling season, over 2,000 20-minute tows are made. Trawling occurred from the beginning of August through the end of June in 1997/98 and 1998/99, after which trawling has occurred year-round. Usually, 10 tows are made per day, and trawling occurs several days per week.

Since the 1998 broodyear, all hatchery steelhead have been ad-clipped. Trawl catches of steelhead provide an estimate of the proportion of wild to hatchery fish, which, combined with estimates of basin-wide hatchery releases, provide an estimator for wild steelhead production:

$$N_w = \frac{C_w}{C_h} N_h \qquad (1)$$

where N_w is the number of wild steelhead, C_w and C_h are the total catches of wild and hatchery steelhead, and N_h is the number of hatchery fish released. The accuracy of the estimate depends on the assumption that hatchery and natural steelhead are equally vulnerable to the trawl gear. In particular, if hatchery fish are more vulnerable to the gear, natural production is underestimated.

Catches of steelhead are sporadic—most sets catch no steelhead, but a few sets catch up to four steelhead. To estimate the mean and variance of C_w / C_h, the trawl data sets were resampled with replacement 1,000 times. The mean C_w / C_h ranged from 0.06 to 0.30, and coefficients of variation ranged from 16% to 37% of the means.

From such calculations, it appears that about 100,000-300,000 steelhead juveniles (roughly, smolts) are produced naturally each year in the Central Valley (Table B.2.10.2). If we make the fairly generous assumptions (in the sense of generating large estimates of spawners) that average fecundity is 5,000 eggs per female, 1% of eggs survive to reach Chipps Island, and 181,000 smolts are produced (the 1998-2000 average), about 3,628 female steelhead spawn naturally in the entire Central Valley. This can be compared with McEwan's (2001) estimate of 1million-2 million spawners before 1850, and 40,000 spawners in the 1960s. Table B.2.10.2 shows the effects of different assumptions about survival on estimates of female spawner abundance.

Table B.2.10.2. Estimated natural production of steelhead juveniles from the Central Valley. C_w/C_h = ratio of unclipped to clipped steelhead; N_r = total hatchery releases; N_w = estimated natural production; ESS = egg-to-smolt survival.

				wild female spawners		
Year	C_w/C_h	N_r (millions)	N_w (thousands)	ESS=1%	ESS=5%	ESS=10%
1998	0.300	1.12	336	6,720	1,344	672
1999	0.062	1.51	94	1,872	374	187
2000	0.083	1.38	115	2,291	458	229
average	0.148	1.34	181	3,628	726	363

Another source of information comes from screw trap operations at Knights Landing on the lower Sacramento River, just above the confluence of the Feather River (Snider and Titus 2000a, 2000b, 2000c). Over the period 1995-1999, estimates of the natural production for the areas above Knights Landing averaged 9,800 yearling steelhead outmigrants (range 7260-11,700). This level of production is about 5% of the total production as estimated above, and may be a substantial underestimate due to application of trap efficiency estimates generated from recaptures of marked chinook juveniles, which probably are less able to avoid traps.

Nobriga and Cadrett (2001) analyzed captures of steelhead in trawls at Chipps Island and in fish salvage facilities associated with water diversions in the southern Delta. They computed average daily catch of hatchery and wild steelhead per unit effort, and used these estimates to estimate the percentage of hatchery fish. They found that hatchery steelhead comprised 63-77% of the trawl catch of steelhead at Chipps Island (compared to 77-92% estimated from the resampling method described above), and generally lower percentages in the south Delta, which

is not surprising since the bulk of hatchery production comes out of Sacramento River basin. This alternative analysis of the Chipps Island trawl data suggests that wild steelhead are roughly three-fold more abundant than the resampling analysis discussed above.

Current Distribution

Recent spawner surveys of small Sacramento River tributaries (Mill, Deer, Antelope, Clear, and Beegum Creeks, Moore 2001) and incidental captures of juvenile steelhead during chinook monitoring (Calaveras, Cosumnes, Stanislaus, Tuolumne, and Merced Rivers) have confirmed that steelhead are widespread, if not abundant, throughout accessible streams and rivers. Much of this information is reviewed by McEwan (2001). Figure B.2.10.3 cartographically summarizes the information on distribution of steelhead in Central Valley streams; details are listed in Table B2.10.3.

CDFG (2003) reported trawl captures of *O. mykiss* at Mossdale on the lower San Joaquin River (below confluence of the Tuolumne, Stanislaus and Merced Rivers). Because the Mossdale area is not suitable habitat for resident *O. mykiss*, these fish are assumed to be steelhead smolts. Between 2 and 30 fish per year were captured in the 1988-2002 period. Rotary screw trap data suggests that the bulk of this production comes from the Stanislaus, although some smolts were captured in the Merced and Tuolumne as well.

Resident *O. mykiss* considerations

Coastal *O. mykiss* is widely distributed in the Central Valley basin. Roughly half of the trout habitat (by area) in the Central Valley is above dams that are impassable to fish; higher elevation habitats appear to support quite high densities of trout, ranging from a few hundred to a few thousand 4”—6” fish per km (see Appendix B.5.2).

There are several areas of substantial uncertainty that make interpreting this information difficult. First, it is not clear how anadromous and non-anadromous coastal *O. mykiss* interacted in the Central Valley before the dam-building era. In other systems, anadromous and non-anadromous *O. mykiss* forms can exist within populations, while in other systems, these groups can be reproductively isolated despite nearly sympatric distributions within rivers (Zimmerman and Reeves, 2000). Second, hatchery produced *O. mykiss* have been widely stocked throughout the Central Valley, Sierra Nevada and southern Cascades. It is possible that this stocking has had deleterious effects on native wild trout populations, although limited information indicates that native trout populations remain in some areas that have received stocked fish (Nielsen et al. 2000).

We suspect that some coastal *O. mykiss* populations that are above man-made barriers could be part of the Central Valley ESU, because these populations were probably exhibiting some degree of anadromy and interacting with each other on evolutionary time scales prior to barrier construction. Due to a lack of data, we cannot, however, identify any particular resident populations as part of the Central Valley ESU.

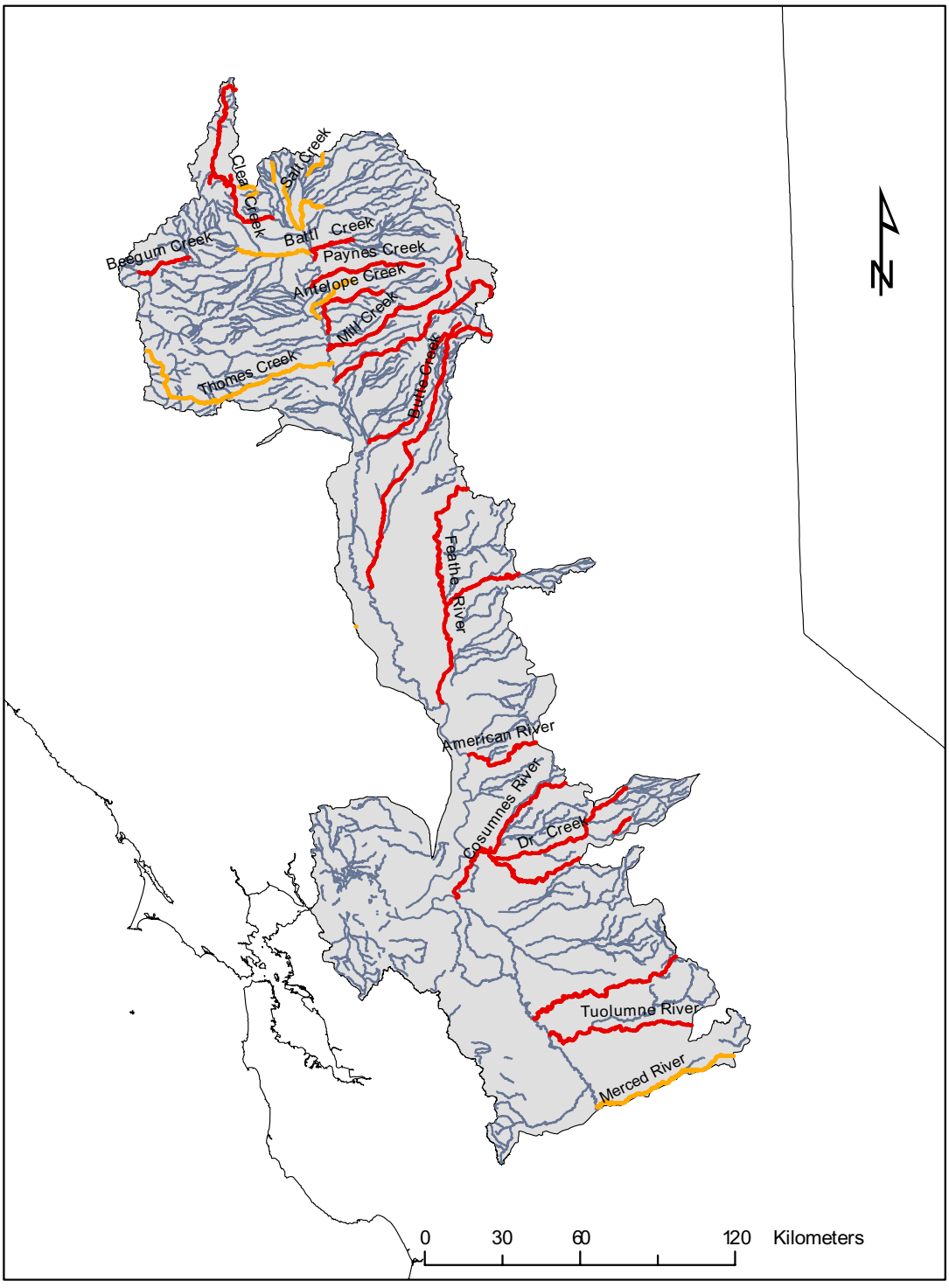

Figure B.2.10.3. Central Valley tributaries known (dark gray lines; bold font) or suspected (medium gray lines; normal font) to be used by steelhead adults. Kerrie Pipal (NMFS Santa Cruz Lab) assembled this information from agency and consultant reports and discussions with CDFG field biologists.

Table B.2.10.3. Summary of distribution information for steelhead in the Central Valley.

System	Tributary	Current presence	Most recent documented date of presence	Count / Life Stage	Comments	Source
Sacramento River	Clear Creek	Yes	2001	Adults/Juvs	Snorkel surveys and redd counts, rotary screw traps	Jess Newton (USFWS), personal communication, Aug 2002
	Rock Creek	Probable	2001	Adults/Juvs	Creek used for spawning	Mike Berry (CDFG), personal communication, Oct 2002.
	Salt Creek	Probable	2001	Adults/Juvs	Possible spawning; non-natal rearing	ibid
	Sulphur Creek	Probable	2001	Adults/Juvs	Creek used for spawning	ibid
	Olney Creek	Probable	2001	Adults/Juvs	Spawning, non-natal rearing	ibid
	Stillwater Creek	Probable	-	-	Non-natal rearing	ibid, Maslin 1998.
	Cow Creek + tribs	Probable	1992	-	Suitable habitat, access problems	CDFG 1993
	Cottonwood Creek	Probable	-	-		CDFG 1993
	Beegum Creek	Yes	2001	Adults		Moore 2001.
	South Fork Cottonwood Creek	Possible	-	-	Large populations of 'rainbow trout'	Mike Berry (CDFG), personal communication, Oct 2002.
	Bear Creek	Possible	-	-		CDFG 1993
	Battle Creek	Yes	2002	-		Kier & Associates 2001. Jess Newton (USFWS), personal communication, Aug 2002.
	Paynes Creek	Yes	2002	Adults	Self-sustaining population unlikely	Mike Berry (CDFG), personal communication, Oct 2002.
	Antelope Creek	Yes	2001	Adults + redds		Moore 2001.
	Mill Creek	Yes	2001	Adults + redds	Small numbers counted.	Moore 2001.
	Elder Creek	Possible	No recent surveys	-	Resident trout present	CDFG 1993

	Thomes Creek	Probable	1969 & 2002	-	Used by chinook, "trout" observed	Puckett 1969, Killam 2002, Mike Berry (CDFG), personal communication, Oct 2002.
	Deer Creek	Yes	2001	Adults + redds		Moore 2001
	Rice Creek	Yes	1998	Juveniles		Maslin 1998
	Big Chico Creek	Yes	-	-		CDFG 1993
	Butte Creek	Yes	2000	-	Report confirms steelhead presence, no details.	USFWS 2000
	Feather River	Yes	1998	YOY + Juvs	Screw trap captures	CDWR 1998
	Yuba River	Yes	1998	-	Report confirms steelhead presence, no details.	IEP 1998
	Deer Creek (Yuba trib)	Yes	1993	Adults	Dive survey	StreamNet database
	Dry Creek	Yes	-	-	Secret and Miners Ravines	R. Titus, CDFG
	American River	Yes	2002	Adults + redds	Counted redds, estimated number of adults based on redd counts.	Hannon and Healey 2002.
	Putah Creek	Yes	2000	-	Very small numbers of adult steelhead make their way to the base of Monticello dam	P. Moyle (UC Davis) public communication http://wdsroot.ucdavis.edu/clients/pcbr/book/04_Lake_Solano/04_04_moyle_fish_lowpc.html
San Joaquin River	Cosumnes River	Yes	1995	-	Smolts salvaged from drying pools	Nobriga 1995
	Mokelumne River	Yes	2001	Adults + juveniles		Workman 2001
	Calaveras River	Yes	2001	Adults + juveniles	Several reports list presence, but do not give any details; angler reports/photos.	Gonzalo Castillo, USFWS personal communication
	Stanislaus River	Yes	2001	YOYs & 1+		Kennedy 2002.
	Tuolumne River	Yes	2001	Juvs	Incidental rotary screw trap captures	CDFG 2003
	Merced River	Possible	2002	Juvs	Incidental rotary screw trap captures, large trout caught be anglers, enter hatchery	David Vogel (NRC), personal communication, June 2002. Michael Cozart (Merced River Hatchery), personal communication, Sept 2002.

Harvest Impacts

Steelhead are caught in freshwater recreational fisheries, and CDFG estimates the number of fish caught. Because the sizes of Central Valley steelhead populations are unknown, however, the impact of these fisheries is unknown. According to CDFG creel census, the great majority (93%) of steelhead catches occur on the American and Feather Rivers, sites of steelhead hatcheries (CDFG 2001). In 2000, 1,800 steelhead were retained and 14,300 were caught and released. The total number of steelhead contacted might be a significant fraction of basin-wide escapement, so even low catch-and-release mortality may pose a problem for wild populations. Additionally, steelhead juveniles may be affected by trout fisheries on some tributaries and the mainstem Sacramento.

The State of California's proposed Fishery Management and Evaluation Plan (part of the requirements to obtain ESA coverage for in-river sport fisheries) was recently rejected by NMFS mostly because of the inadequacy of existing and proposed monitoring of fisheries impacts.

B.2.10.3 New Hatchery Information

There is little new information pertaining to hatchery stocks of steelhead in the Central Valley. Figures B.2.10.4 and B.2.10.5 show the releases and returns of steelhead to and from Central Valley hatcheries. As discussed above in the section on new abundance information, hatchery steelhead juveniles dominate catches in the Chipps Island trawl, suggesting that hatchery production is large relative to natural production. Note that Mokelumne River Hatchery and Nimbus Hatchery stocks are not part of the CV ESU due to broodstock source and genetic, behavioral, and morphological similarity to Eel River stocks. Categorization of Central Valley steelhead hatchery stocks (SSHAG 2003) can be found in Appendix B.5.3.

B.2.10.4 Comparison with Previous Data

The few new pieces of information do not indicate a dramatic change in the status of the Central Valley ESU. The Chipps Island trawl data suggest that the population decline evident in the RBDD counts and the previously noted decline in the proportion of wild fish is continuing. The fundamental habitat problems are little changed, with the exception of some significant restoration actions on Butte Creek. There is still a nearly complete lack of steelhead monitoring in the Central Valley.

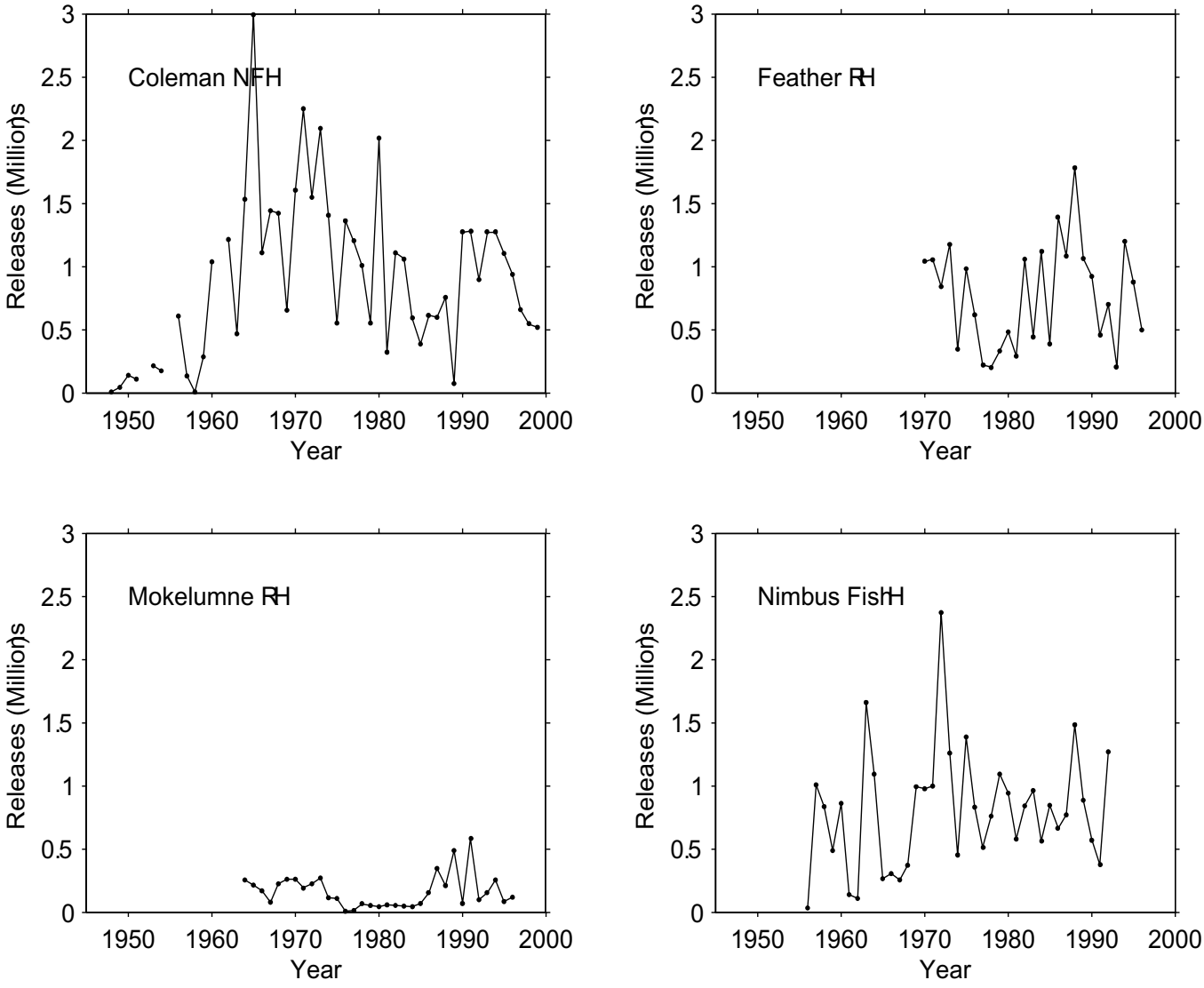

Figure B.2.10.4. Releases of steelhead from Central Valley hatcheries

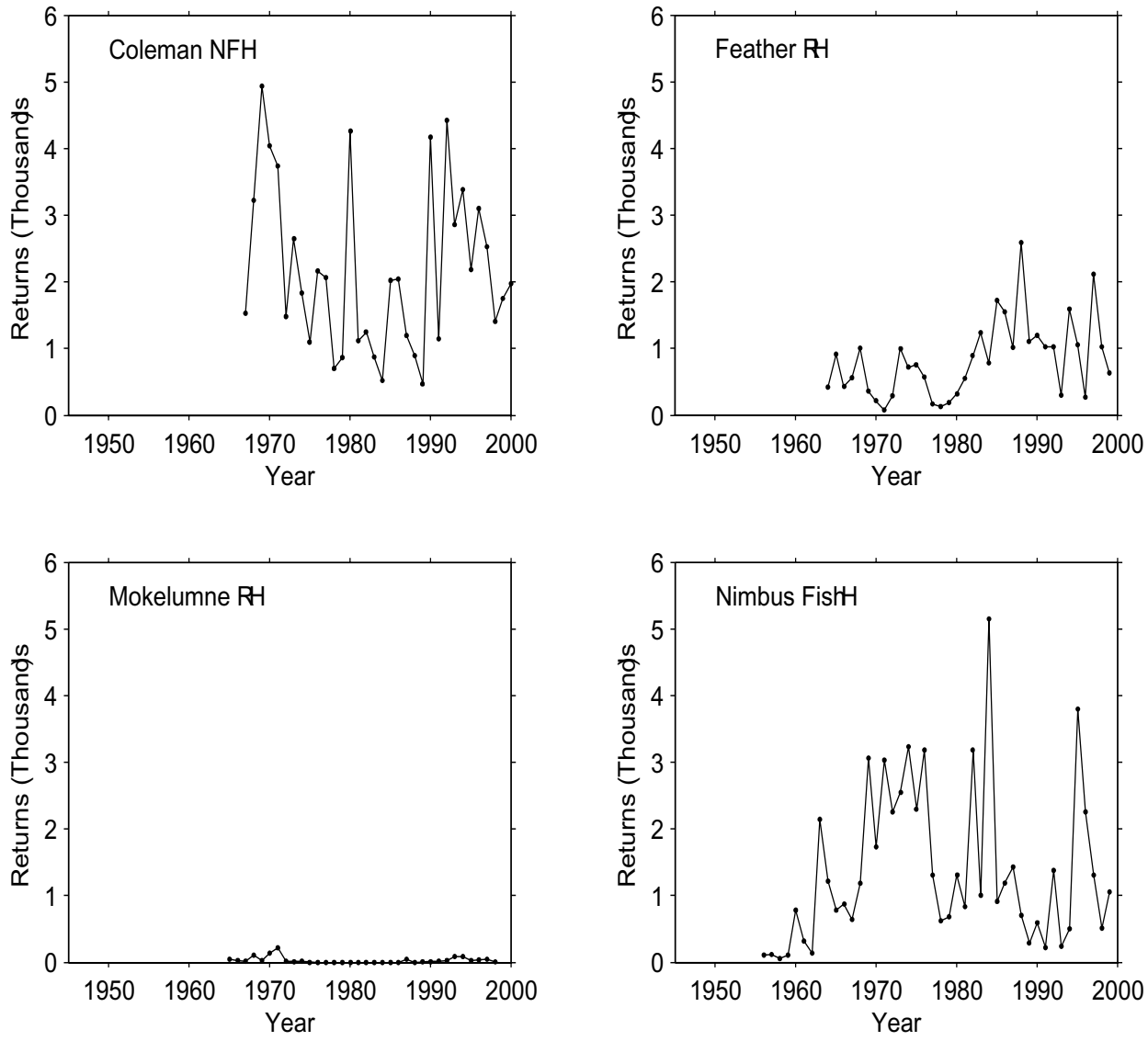

Figure B.2.10.5. Returns of steelhead to Central Valley hatcheries.

B.3 STEELHEAD BRT CONCLUSIONS

The ESA (Sec. 3) allows listing of "species, subspecies, and distinct population segments." The option to list subspecies is not available for Pacific salmon, since no formally recognized subspecies exist. However, a number of subspecies have been identified for *O. mykiss*, including two that occur in North America and have anadromous populations. According to Behnke (1992), *O. mykiss irideus* (the "coastal" subspecies) includes coastal populations from Alaska to California (including the Sacramento River), while *O. mykiss gairdneri* (the "inland" subspecies) includes populations from the interior Columbia, Snake and Fraser Rivers. Both subspecies thus include populations within the geographic range of this updated status review, but both also include northern populations outside the geographic range considered here. The BRT did not attempt to evaluate extinction risk to *O. mykiss* at the species or subspecies level; instead, we evaluated risk at the distinct population segment (ESU) level, as for the other species considered in this report.

Snake River steelhead ESU

A majority (over 70%) of the BRT votes for this ESU fell in the "likely to become endangered" category, with small minorities falling in the "danger of extinction" and "not likely to become endangered" categories (Table B.3.1). The BRT did not identify any extreme risks for this ESU but found moderate risks in all the VSP categories (mean risk matrix scores ranged from 2.5 for spatial structure to 3.2 for growth rate/productivity) (Table B.3.2). The continuing depressed status of B-run populations was a particular concern. Paucity of information on adult spawning escapements to specific tributary production areas makes a quantitative assessment of viability for this ESU difficult. As indicated in previous status reviews, the BRT remained concerned about the replacement of naturally produced fish by hatchery fish in this ESU; naturally produced fish now make up only a small fraction of the total adult run. Again, lack of key information considerably complicates the risk analysis. Although several large production hatcheries for steelhead occur throughout this ESU, relatively few data exist regarding the numbers and relative distribution of hatchery fish that spawn naturally, or the consequences of such spawnings when they do occur.

On a more positive note, sharp upturns in 2000 and 2001 in adult returns in some populations and evidence for high smolt-adult survival indicate that populations in this ESU are still capable of responding to favorable environmental conditions. In spite of the recent increases, however, abundance in most populations for which there are adequate data are well below interim recovery targets (NMFS 2002).

Based on the provisional framework discussed in the general Introduction to this report, the BRT assumed as a working hypothesis that resident fish below historical barriers are part of this ESU, while those above long-standing natural barriers (e.g., in the Palouse and Malad Rivers) are not. Recent genetic data suggest that native resident *O. mykiss* above Dworshak Dam on the North Fork Clearwater River should be considered part of this ESU, but hatchery rainbow trout that have been introduced to that and other areas would not. The BRT did not attempt to resolve the ESU status of resident fish residing above the Hell's Canyon Dam complex, as little new information is available relevant to this issue. However, Kostow (2003) suggested that,

based on substantial ecological differences in habitat, the anadromous *O. mykiss* that historically occupied basins upstream of Hells Canyon (e.g., Powder, Burnt, Malheur, Owhyee rivers) may have been in a separate ESU. For many BRT members, the presence of relatively numerous resident fish mitigated the assessment of extinction risk for the ESU as a whole.

Upper Columbia River steelhead ESU

A slight majority (54%) of the BRT votes for this ESU fell in the "danger of extinction" category, with most of the rest falling in the "likely to become endangered" category (Table B.3.1). The most serious risk identified for this ESU was growth rate/productivity (mean score 4.3); scores for the other VSP factors were also relatively high, ranging from 3.1 (spatial structure) to 3.6 (diversity) (Table B.3.2). The last 2-3 years have seen an encouraging increase in the number of naturally produced fish in this ESU. However, the recent mean abundance in the major basins is still only a fraction of interim recovery targets (NMFS 2002). Furthermore, overall adult returns are still dominated by hatchery fish, and detailed information is lacking regarding productivity of natural populations. The ratio of naturally produced adults to the number of parental spawners (including hatchery fish) remains low for upper Columbia steelhead. The BRT did not find data to suggest that the extremely low replacement rate of naturally spawning fish (estimated adult: adult ratio was only 0.25-0.3 at the time of the last status review update) has improved substantially.

Based on the provisional framework discussed in the general Introduction to this report, the BRT assumed as a working hypothesis that resident fish below historical barriers are part of this ESU, while those above long-standing natural barriers (e.g., in the Entiat, Methow, and perhaps Okanogan basins) are not. Resident fish potentially occur in all areas in the ESU used by steelhead. Case 3 resident fish above Conconully Dam are of uncertain ESU affinity. The BRT did not attempt to resolve the ESU status of resident fish residing above Grand Coulee Dam, as little new information is available relevant to this issue. Possible ESU scenarios for these fish include 1) they were historically part of the ESU and many of the remnant resident populations still are part of this ESU; 2) they were historically part of the ESU but no longer are, due to either introductions of hatchery rainbow trout or rapid evolution in a novel environment; or 3) they were historically part of a separate ESU. For many BRT members, the presence of relatively numerous resident fish mitigated the assessment of extinction risk for the ESU as a whole.

Middle Columbia River steelhead ESU

A slight majority (51%) of the BRT votes for this ESU fell in the "likely to become endangered" category, with a substantial minority (49%) falling in the "not likely to become endangered" category (Table B.3.1). The BRT did not identify any extreme risks for this ESU but found moderate risks in all the VSP categories (mean risk matrix scores ranged from 2.5 for diversity to 2.7 for abundance) (Table B.3.2).

This ESU proved difficult to evaluate for two reasons. First, the status of different populations within the ESU varies greatly. On the one hand the abundance in two major basins, the Deschutes and John Day, is relatively high and over the last five years is close to or slightly

over the interim recovery targets (NMFS 2002). On the other hand, steelhead in the Yakima basin, once a large producer of steelhead, remain severely depressed (10% of the interim recovery target), in spite of increases in the last 2 years. Furthermore, in recent years escapement to spawning grounds in the Deschutes River has been dominated by stray, out-of-basin (and largely out-of-ESU) fish—which raises substantial questions about genetic integrity and productivity of the Deschutes population. The John Day is the only basin of substantial size in which production is clearly driven by natural spawners. For the other major basin in the ESU (the Klickitat), no quantitative abundance information is available. The other difficult issue centered on how to evaluate contribution of resident fish, which according to Kostow (2003) and other sources are very common in this ESU and may greatly outnumber anadromous fish. The BRT concluded that the relatively abundant and widely distributed resident fish mitigated extinction risk in this ESU somewhat. However, due to significant threats to the anadromous component the majority of BRT members concluded the ESU was likely to become endangered.

Historically, resident fish are believed to have occurred in all areas in the ESU used by steelhead, although current distribution is more restricted. Based on the provisional framework discussed in the general Introduction to this report, the BRT assumed as a working hypothesis that resident fish below historical barriers are part of this ESU, while those above long-standing natural barriers (e.g., in Deschutes and John Day basins) are not. Case 3 resident fish above Condit Dam in the Little White Salmon; above Pelton and Round Butte Dams (but below natural barriers) in the Deschutes; and above irrigation dams in the Umatilla Rivers are of uncertain ESU status.

Lower Columbia River steelhead ESU

A large majority (over 79%) of the BRT votes for this ESU fell in the "likely to become endangered" category, with small minorities falling in the "danger of extinction" and "not likely to become endangered" categories (Table B.3.1). The BRT found moderate risks in all the VSP categories, with mean risk matrix scores ranging from 2.7 for spatial structure to 3.3 for both abundance and growth rate/productivity) (Table B.3.2). All of the major risk factors identified by previous BRTs still remain. Most populations are at relatively low abundance, and those with adequate data for modeling are estimated to have a relatively high extinction probability. Some populations, particularly summer run, have shown higher returns in the last 2-3 years. The Willamette Lower Columbia River TRT (Myers et al. 2002) has estimated that at least four historical populations are now extinct. The hatchery contribution to natural spawning remains high in many populations.

Based on the provisional framework discussed in the general Introduction to this report, the BRT assumed as a working hypothesis that resident fish below historical barriers are part of this ESU, while those above long-standing natural barriers (e.g., in upper Clackamas, Sandy, and some of the small tributaries of the Columbia River Gorge) are not. Case 3 resident fish above dams on the Cowlitz, Lewis, and Sandy Rivers are of uncertain ESU status.

Upper Willamette River steelhead ESU

The majority (over 76%) of the BRT votes for this ESU fell in the "likely to become endangered" category, with small minorities falling in the "danger of extinction" and "not likely to become endangered" categories (Table B.3.1). The BRT did not identify any extreme risks for this ESU but found moderate risks in all the VSP categories (mean risk matrix scores ranged from 2.6 for diversity to 2.9 for both spatial structure and growth rate/productivity) (Table B.3.2). On a positive note, after a decade in which overall abundance (Willamette Falls count) hovered around the lowest levels on record, adult returns for 2001 and 2002 were up significantly, on par with levels seen in the 1980s. Still, the total abundance is small for an entire ESU, resulting in a number of populations that are each at relatively low abundance. The recent increases are encouraging but it is uncertain whether they can be sustained. The BRT considered it a positive sign that releases of the "early" winter-run hatchery population have been discontinued, but remained concerned that releases of non-native summer-run steelhead continue.

Because coastal cutthroat trout is a dominant species in the basin, resident *O. mykiss* are not as widespread here as in areas east of the Cascades. Resident fish below barriers are found in the Pudding/Molalla, Lower Santiam, Calapooia, and Tualatin drainages, and these would be considered part of the steelhead ESU based on the provisional framework discussed in the general Introduction. Resident fish above Big Cliff and Detroit Dams on the North Fork Santiam and above Green Peter Dam on the South Fork Santiam are of uncertain ESU affinity. Although no obvious physical barrier separates populations upstream of the Calapooia from those lower in the basin, resident *O. mykiss* in these upper reaches of the Willamette basin are quite distinctive both phenotypically and genetically and are not considered part of the steelhead ESU.

Northern California steelhead ESU

The majority (74%) of BRT votes were for "likely to become endangered," with the remaining votes split about equally between "in danger of extinction" and "not warranted" (Table B.3.1). Abundance and productivity were of some concern (scores of 3.7; 3.3 in the risk matrix); spatial structure and diversity were of lower concern (scores of 2.2; 2.5); although at least one BRT member gave scores as high as 4 for each of these risk metrics (Table B.3.2).

The BRT considered the lack of data for this ESU to be a source of risk due to uncertainty. The lack of recent data is particularly acute for winter runs. While there are older data for several of the larger river systems that imply run sizes became much reduced since the early twentieth century, there are no recent data suggesting much of an improvement.

Based on the provisional framework discussed in the general Introduction to this report, the BRT assumed as a working hypothesis that resident fish below historical barriers are part of the Northern California Coast Steelhead ESU, while those above long-standing natural barriers are not. Historically, resident fish are believed to have occurred in all areas in the ESU used by steelhead, although current distribution is more restricted. Resident fish above recent (usually man-made) barriers--including Robert W. Matthews Dam on the Mad River and Scott Dam on the Eel River--but below natural barriers are of uncertain ESU affinity. In this ESU, the inclusion of resident fish would not greatly increase the total numbers of fish, and the resident fish have not been exposed to large amounts of hatchery stocking.

Central California Coast steelhead ESU

The majority (69%) of BRT votes were for "likely to become endangered," and another 25% were for "in danger of extinction" (Table B.3.1). Abundance and productivity were of relatively high concern (mean score of 3.9 for each, with a range of 3 to 5 for each), and spatial structure was also of concern (score 3.6) (Table B.3.2). Predation by pinnipeds at river mouths and during the ocean phase was noted as a recent development posing significant risk.

There were no time-series data for this ESU. A variety of evidence suggested the largest run in the ESU (the Russian River winter steelhead run) has been reduced in size and continues to be reduced in size. Concern was also expressed about the populations in the southern part of the range of the ESU--notably populations in Santa Cruz County and the South Bay area.

Based on the provisional framework discussed in the general Introduction to this report, the BRT assumed as a working hypothesis that resident fish below historical barriers are part of the Central California Coast Steelhead ESU, while those above long-standing natural barriers are not. Historically, resident fish are believed to have occurred in all areas in the ESU used by steelhead, although current distribution is more restricted. Resident fish above recent (usually man-made) barriers--including Warm Springs Dam on Dry Creek, Russian River; Coyote Dam on the East Fork Russian River; Seeger Dam on Lagunitas Creek; Peters Dam on Nicasio Creek, Lagunitas Creek; and Standish Dam on Coyote Creek--but below natural barriers are of uncertain ESU affinity. In this ESU, an estimated 22% of historical habitat is behind recent barriers. The only relevant biological information about the populations above these barriers pertains to Alameda Creek, and suggests that some but not all populations above Dam 1 are genetically similar to populations within the ESU. For some BRT members, the presence of resident fish mitigated the assessment of extinction risk for the ESU as a whole.

South-Central California Coast steelhead ESU

The majority (68%) of BRT votes were for "likely to become endangered," and another 25% were for "in danger of extinction" (Table B.3.1). The strongest concern was for spatial structure (score 3.9; range 3-5), but abundance and productivity were also a concern (Table B.3.2). The cessation of plants to the ESU from the Big Creek Hatchery (Central Coast ESU) was noted as a positive development, whereas continued predation from sport fishers was considered a negative development.

New data suggests that populations of steelhead exist in most of the streams within the geographic boundaries of the ESU; however, the BRT was concerned that the two largest river systems—the Pajaro and Salinas basins—are much degraded and have steelhead runs much reduced in size. Concern was also expressed about the fact that these two large systems are ecologically distinct from the populations in the Big Sur area and San Luis Obispo County, and thus their degradation affects spatial structure and diversity of the ESU. Much discussion centered on the dataset from the Carmel River, including the effects of the drought in the 1980s, the current dependence of the population on intensive management of the river system, and the vulnerability of the population to future droughts.

Based on the provisional framework discussed in the general Introduction to this report, the BRT assumed as a working hypothesis that resident fish below historical barriers are part of the South-Central California Coast Steelhead ESU, while those above long-standing natural barriers are not. Historically, resident fish are believed to have occurred in all areas in the ESU used by steelhead, although current distribution is more restricted. Resident fish above recent (usually man-made) barriers--including San Antonia, Nacimiento, and Salinas dams on the Salinas River; Los Padres Dam on the Carmel River; Whale Rock Dam on Old Creek; and Lopez Dam on Arroyo Grande Creek--but below natural barriers are of uncertain ESU affinity. In this ESU, little of the historical habitat is behind recent barriers and most of that on the Salinas River. For some BRT members, the presence of resident fish mitigated the assessment of extinction risk for the ESU as a whole.

Southern California steelhead ESU

The majority (81%) of BRT votes were for "in danger of extinction," with the remaining 19% of votes being for "likely to become endangered" (Table B.3.1). Extremely strong concern was expressed for abundance, productivity, and spatial structure (mean scores of 4.8, 4.3, and 4.8, respectively, in the risk matrix), and diversity was also of concern (mean score of 3.6) (Table B.3.2).

The BRT expressed concern about the lack of data on this ESU, about uncertainty as to the metapopulation dynamics in the southern part of the range of the ESU, and about the fish's nearly complete extirpation from the southern part of the range. Several members were concerned and uncertain about the relationship between the population in Sespe Canyon, which is supposedly a sizeable population, and the small run size passing through the Santa Clara River, which connects the Sespe to the ocean. There was some skepticism that flows in the Santa Maria River were sufficient to allow fish passage from the ocean to the Sisquoc River, another "stronghold" of *O. mykiss* in the ESU.

Based on the provisional framework discussed in the general Introduction to this report, the BRT assumed as a working hypothesis that resident fish below historical barriers are part of the South California Steelhead ESU, while those above long-standing natural barriers are not. Historically, resident fish are believed to have occurred in all areas in the ESU used by steelhead, although current distribution is more restricted. Resident fish above recent (usually man-made) barriers--including Twitchell Dam on the Cuyama River; Bradbury Dam on the Santa Ynez River; Casitas Dam on Coyote Creek, Ventura River; Matilija Dam on Matilija Creek, Ventura River; Santa Felicia Dam on Piru Creek, Santa Clara River; and Casitac Dam on Casitac Creek, Santa Clara River--but below natural barriers are of uncertain ESU affinity. In this ESU, a large portion of the original area is behind barriers, and the few density estimates that are available from this ESU indicate that the inclusion of area above recent barriers would substantially increase the number of fish in the ESU. Due to the extremely low numbers of anadromous fish in this ESU, it is possible that above-barrier populations contribute a significant number of fish to the below-barrier population by spill over. For some BRT members, the presence of resident fish mitigated the assessment of extinction risk for the ESU as a whole.

California Central Valley steelhead ESU

The majority (66%) of BRT votes were for "in danger of extinction", and the remainder was for "likely to become endangered" (Table B.3.1). Abundance, productivity and spatial structure were of highest concern (4.2-4.4), although diversity considerations were of significant concern (3.6) (Table B.3.2). All categories received a 5 from at least one BRT member.

The BRT was highly concerned by the fact that what little new information was available indicated that the monotonic decline in total abundance and in the proportion of wild fish in the ESU was continuing. Other major concerns included the loss of the vast majority of historical spawning areas above impassable dams, the lack of any steelhead-specific status monitoring, and the significant production of out-of-ESU steelhead by the Nimbus and Mokelumne River fish hatcheries. The BRT viewed the anadromous life-history form as a critical component of diversity within the ESU and did not place much importance on sparse information suggesting widespread and abundant *O. mykiss* populations in areas above impassable dams. Dams both reduce the scope for expression of the anadromous life-history form, thereby greatly reducing the abundance of anadromous *O. mykiss*, and prevent exchange of migrants among resident populations, a process presumably mediated by anadromous fish.

Based on the provisional framework discussed in the general Introduction to this report, the BRT assumed as a working hypothesis that resident fish below historical barriers are part of the California Central Valley Steelhead ESU, while those above long-standing natural barriers are not. Historically, resident fish are believed to have occurred in all areas in the ESU used by steelhead, although current distribution is more restricted. Resident fish above recent (usually man-made) barriers--including Shasta Dam on the Upper Sacramento River; Whiskeytown Dam on Clear Creek; Black Butte Dam on Stony Creek; Oroville Dam on the Feather River; Englebright Dam on the Yuba River; Camp Far West Dam on the Bear River; Nimbus Dam on the American River; Commanche Dam on the Mokelumne River; New Hogan Dam on the Calaveras River; Goodwin Dam on the Stanislaus River; La Grange Dam on the Tuolumne River; and Crocker Diversion Dam on the Merced River--but below natural barriers are of uncertain ESU affinity. As noted above, collectively these dams have isolated a large fraction of historical steelhead habitat, and resident fish above the dams may outnumber ESU fish from below the dams.

Table B.3.1. Tally of FEMAT vote distribution regarding the status of 10 steelhead ESUs reviewed. Each of 16 BRT members allocated 10 points among the three status categories.

ESU	Danger of Extinction	Likely to Become Endangered	Not Likely to Become Endangered
Snake River[1]	14	103	23
Upper Columbia[1]	75	62	3
Middle Columbia[1]	1	71	68
Lower Columbia[2]	10	110	30
Upper Willamette[2]	7	106	37
Northern California	18	119	23
Central California Coast	40	111	9
South Central California	40	109	11
Southern California	129	31	0
Central Valley	106	54	0

[1] Votes tallied for 14 BRT members
[2] Votes tallied for 15 BRT members

Table B.3.2. Summary of risk scores (1 = low to 5 = high) for four VSP categories (see section "Factors Considered in Status Assessments" for a description of the risk categories) for the 10 steelhead ESUs reviewed. Data presented are means (range).

ESU	Abundance	Growth Rate/Productivity	Spatial Structure and Connectivity	Diversity
Snake River	3.1 (2-4)	3.2 (2-4)	2.5 (1-4)	3.1 (2-4)
Upper Columbia	3.5 (2-4)	4.3 (3-5)	3.1 (2-4)	3.6 (2-5)
Middle Columbia	2.7 (2-4)	2.6 (2-3)	2.6 (2-4)	2.5 (2-4)
Lower Columbia	3.3 (2-5)	3.3 (3-4)	2.7 (2-4)	3.0 (2-4)
Upper Willamette	2.8 (2-4)	2.9 (2-4)	2.9 (2-4)	2.6 (2-3)
Northern California	3.7 (3-5)	3.3 (2-4)	2.2 (1-4)	2.5 (1-4)
Central California Coast	3.9 (3-5)	3.9 (3-5)	3.6 (2-5)	2.8 (2-4)
South Central California	3.7 (2-5)	3.3 (2-4)	3.9 (3-5)	2.9 (2-4)
Southern California	4.8 (4-5)	4.3 (3-5)	4.8 (4-5)	3.6 (2-5)
Central Valley	4.4 (4-5)	4.3 (4-3)	4.2 (2-5)	3.6 (2-5)

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